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(54) **PANEL CLAMPING AND MOUNTING MECHANISM**

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(51) **Int. Cl.**

F16B 5/06	(2006.01)
F24J 2/52	(2006.01)
F24J 2/54	(2006.01)

(52) **U.S. Cl.**

CPC ***F24J 2/5258*** (2013.01); ***F16B 5/0635*** (2013.01); ***F24J 2/5232*** (2013.01); ***F24J 2/5245*** (2013.01); ***F24J 2/5264*** (2013.01); *F24J 2/541* (2013.01); *Y02E 10/47* (2013.01)

(58) **Field of Classification Search**

CPC F16B 1/00; F16B 5/00; F16B 5/06; F16B 5/0607; F16B 5/0635; F16B 5/0685; B25B 1/00; B25B 1/06; B25B 1/103; B25B 1/2405; B25B 5/00; B25B 5/16; F24J 2/5258

USPC 52/461, 463, 467, 780, 509, 512; 248/231.61, 316.1, 316.2, 316.6, 125.8

See application file for complete search history.

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Primary Examiner — Michael Safavi

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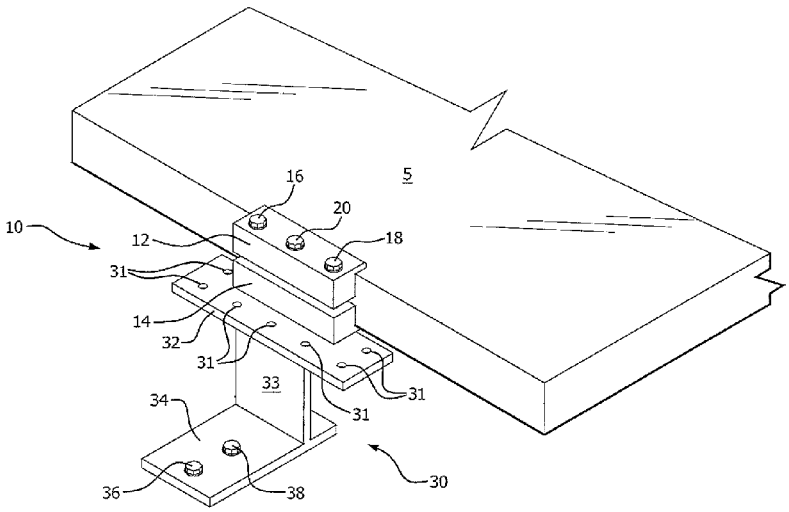
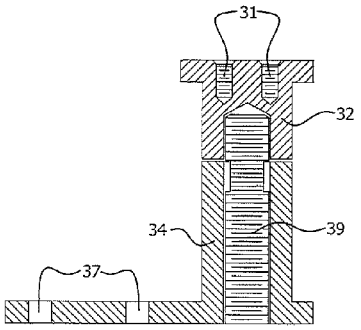
(57) **ABSTRACT**

The present invention relates to a panel clamp securable to a variety of mounting mechanisms. The clamp includes first and second members, each having an edge extending beyond at least a portion of its side surface to form an overhang, and each includes a plurality of holes passing therethrough. When the overhang of the first member is fitted over a top surface of a panel and the overhang of the second member is fitted over a bottom surface of the panel, such that the plurality of holes in the first member is substantially aligned with the plurality of holes in the second member, mechanical fasteners can be inserted through the plurality of holes to secure the first and second members to the panel. An additional mechanical fastener is inserted through the clamp to secure the clamp to a mounting mechanism.

6 Claims, 12 Drawing Sheets





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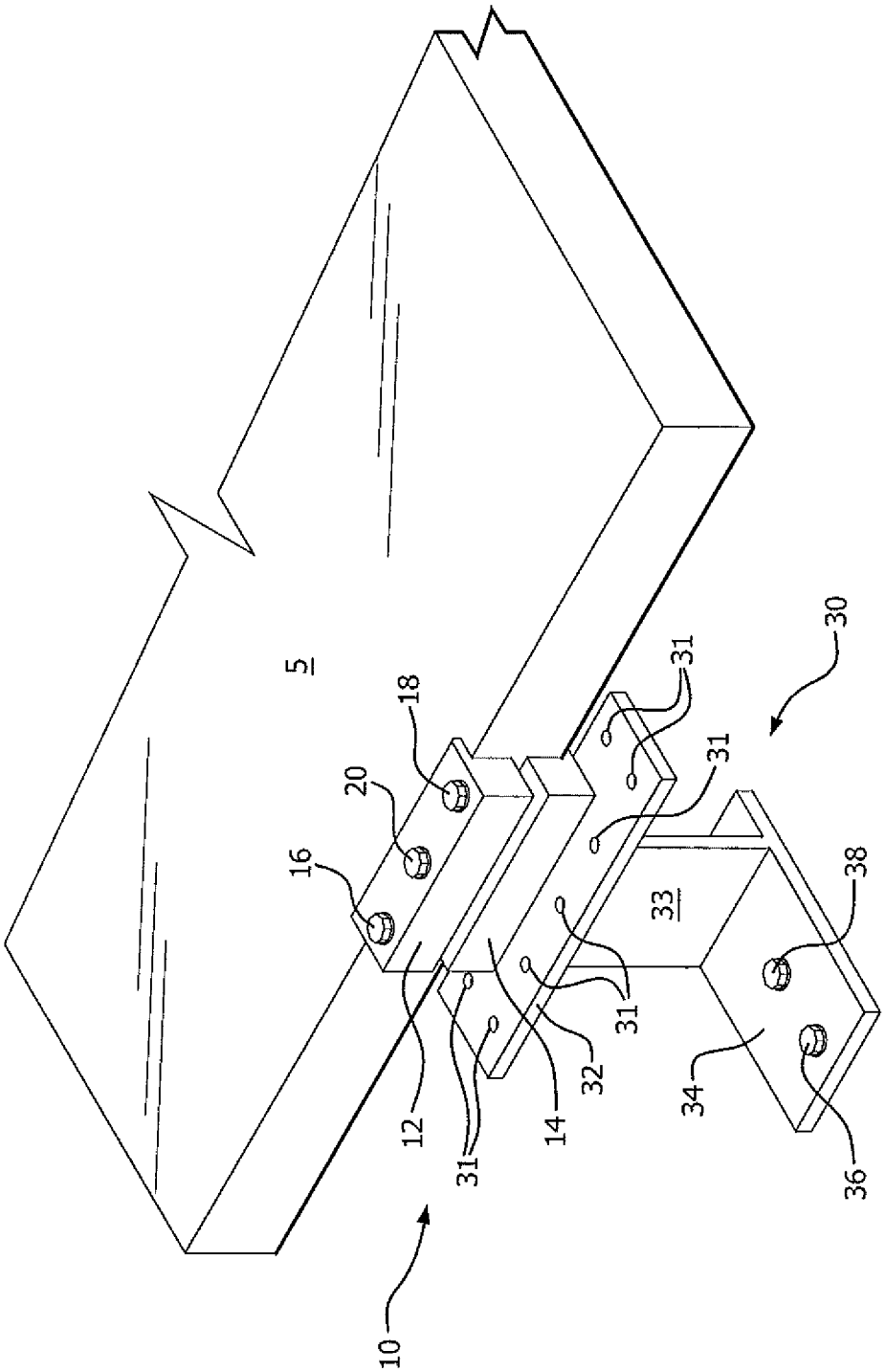


FIG. 1

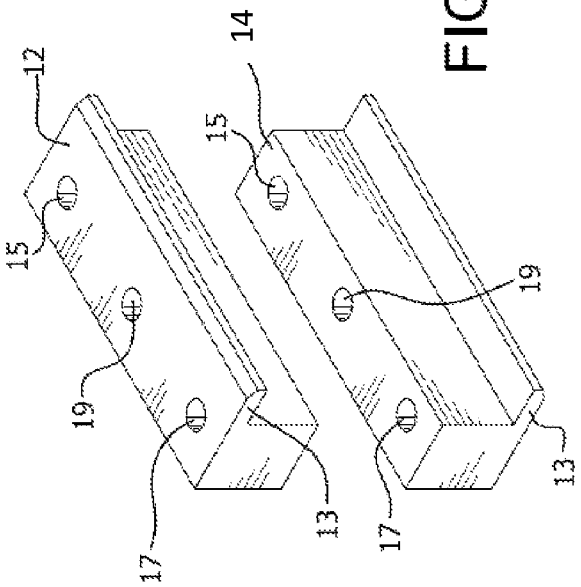


FIG. 2A

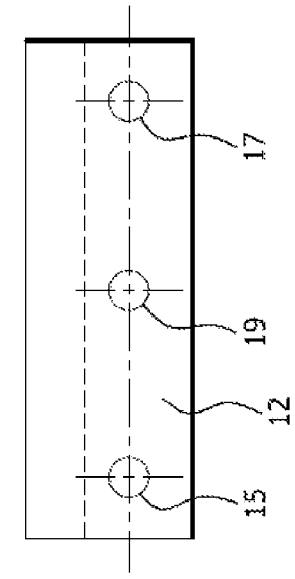


FIG. 2C

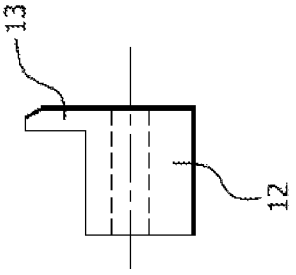


FIG. 2B

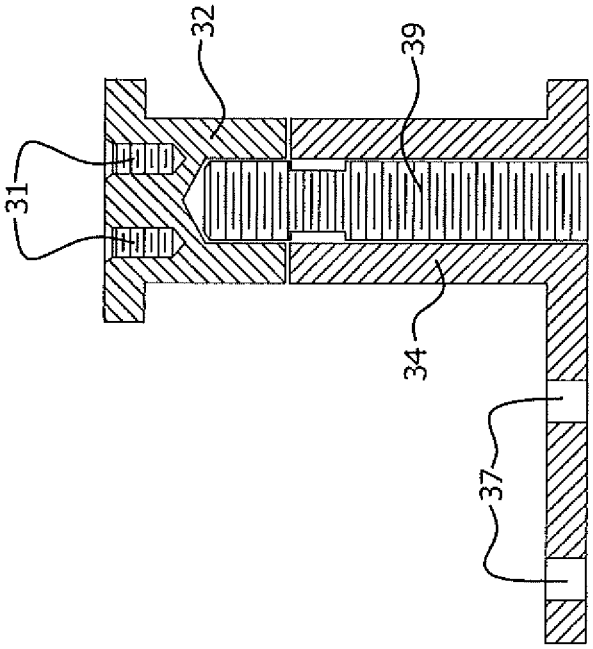


FIG. 3B

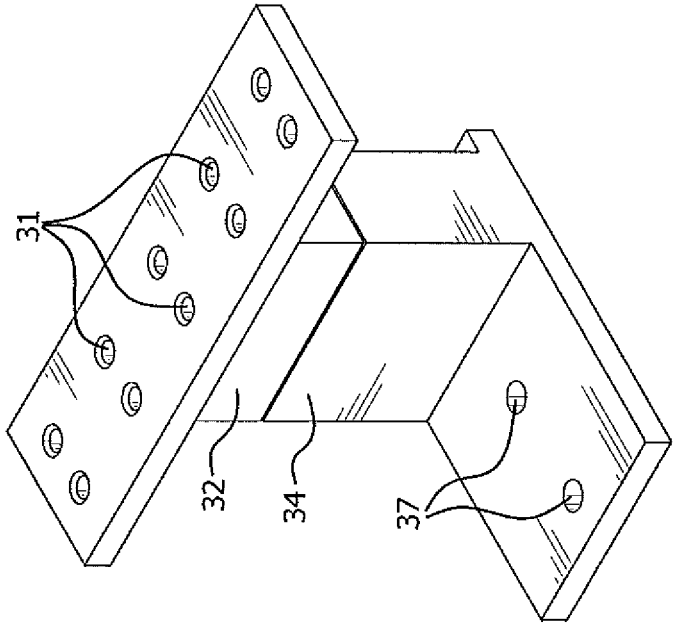
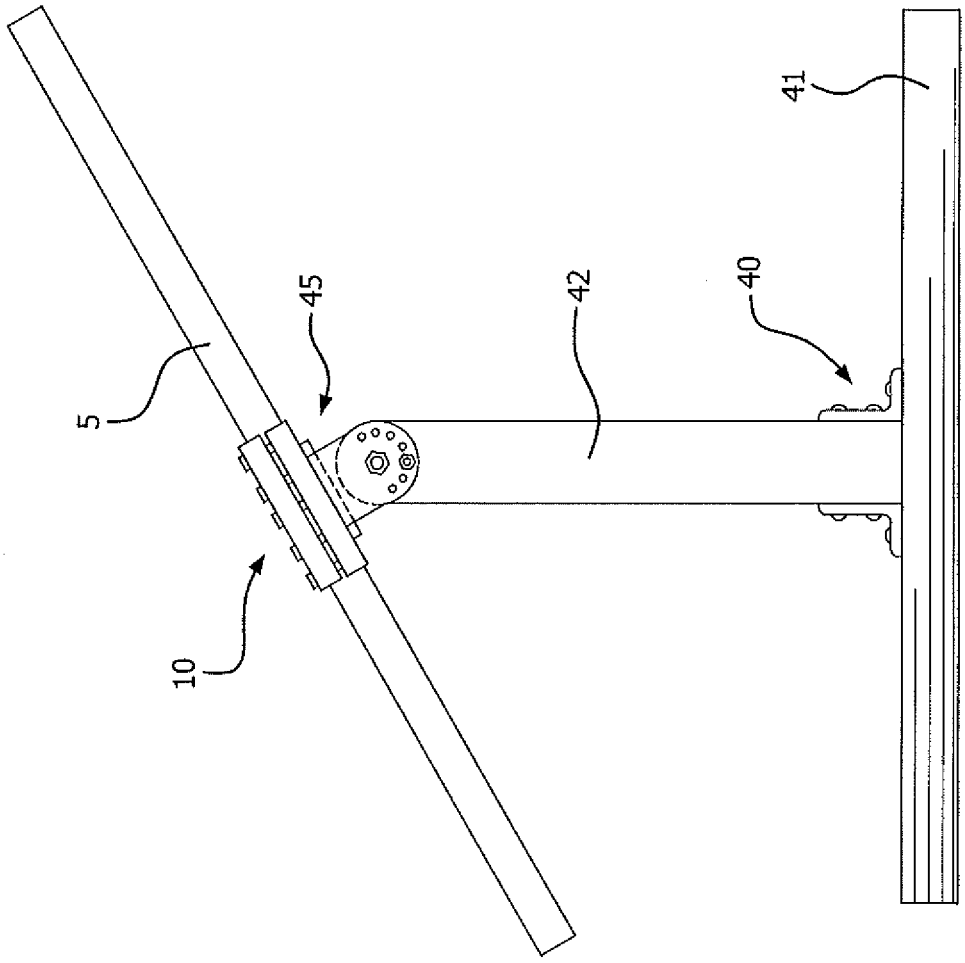


FIG. 3A

FIG. 4



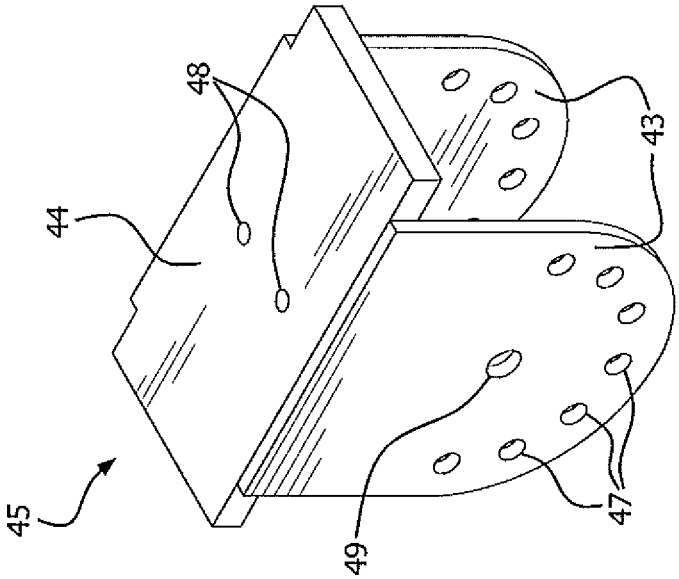


FIG. 5B

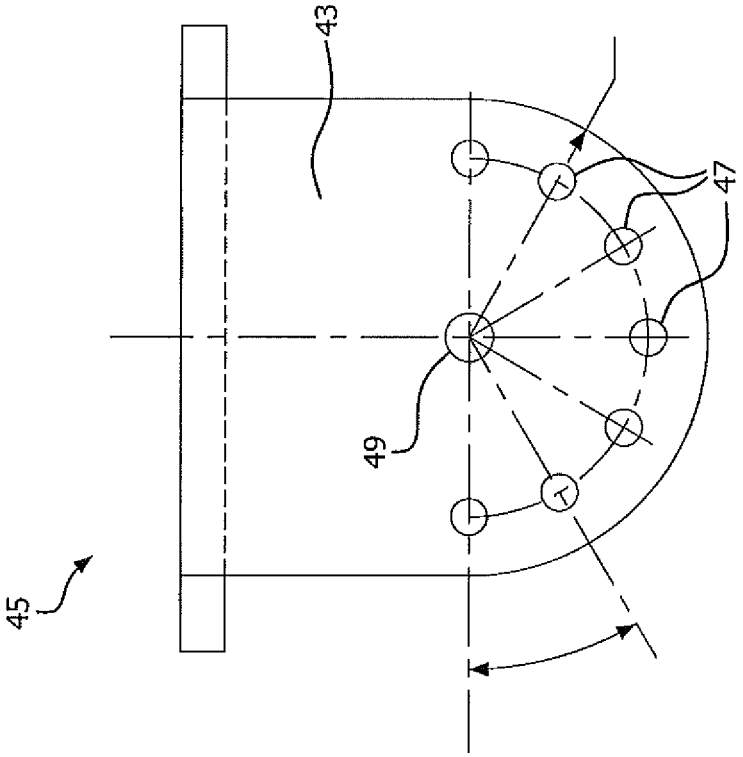


FIG. 5A

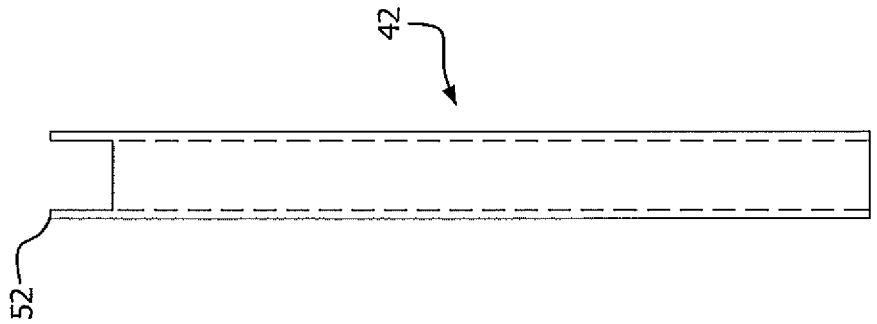


FIG. 6B

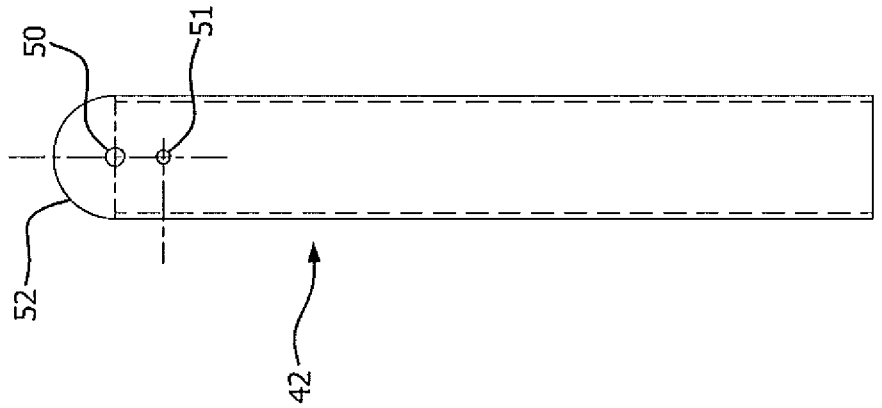


FIG. 6A

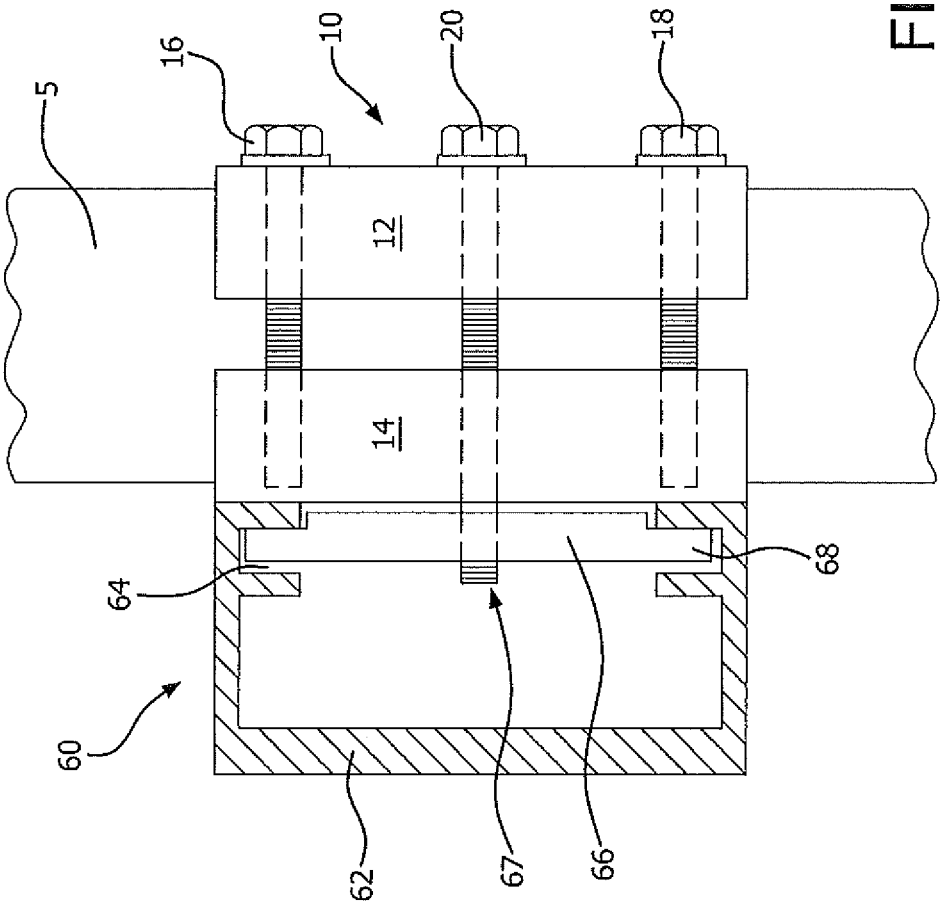


FIG. 7

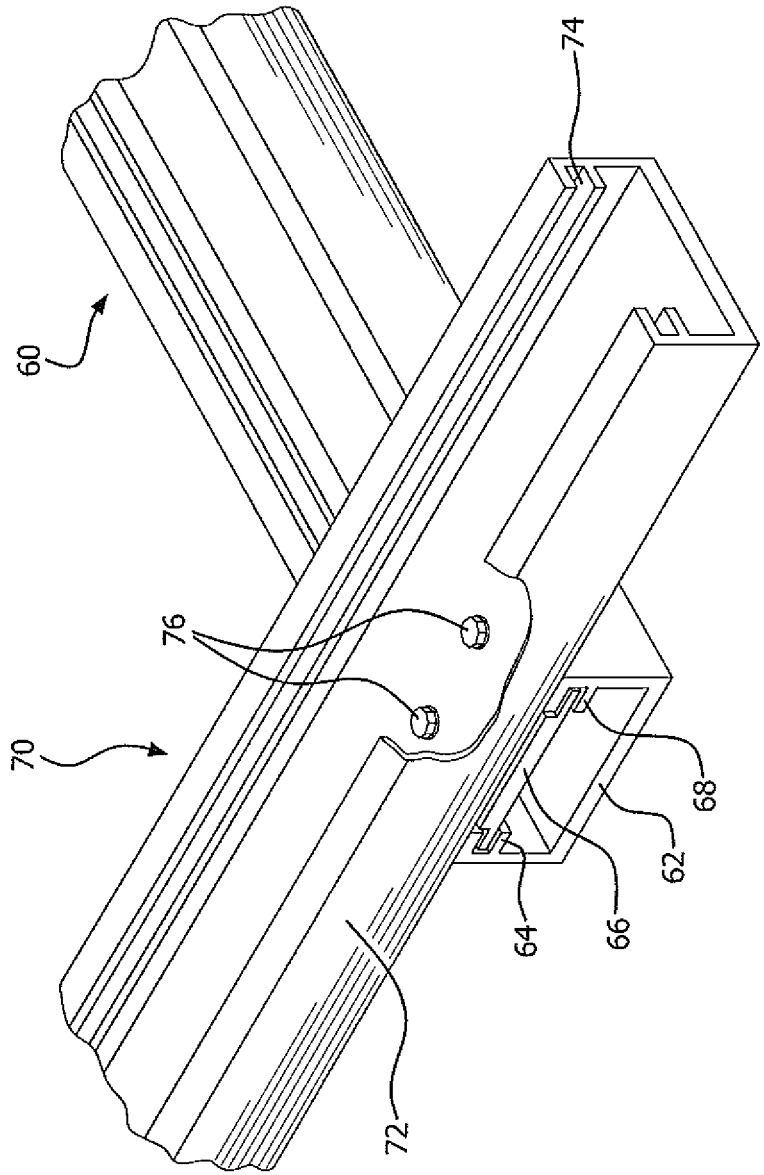


FIG. 8

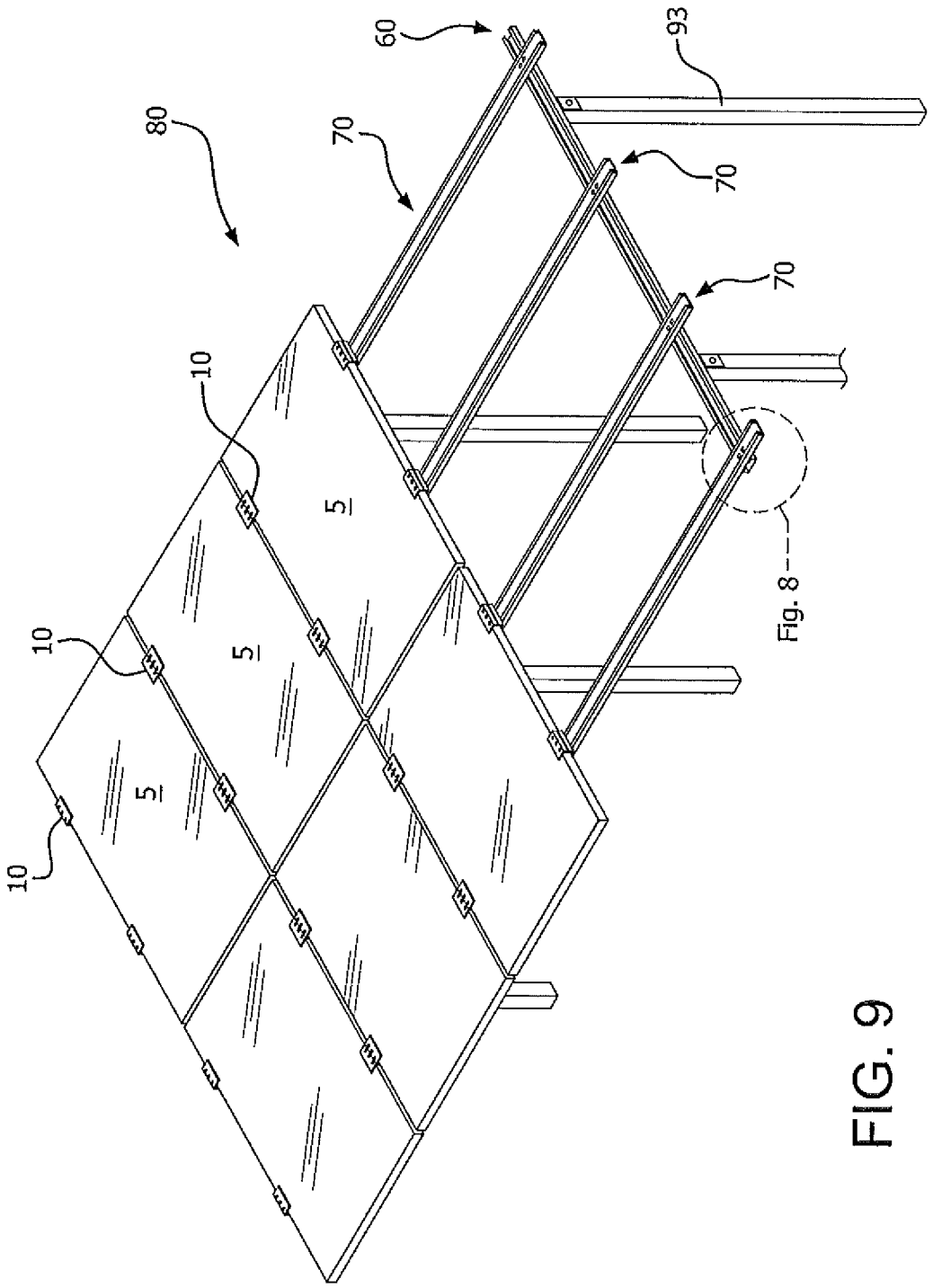


FIG. 9

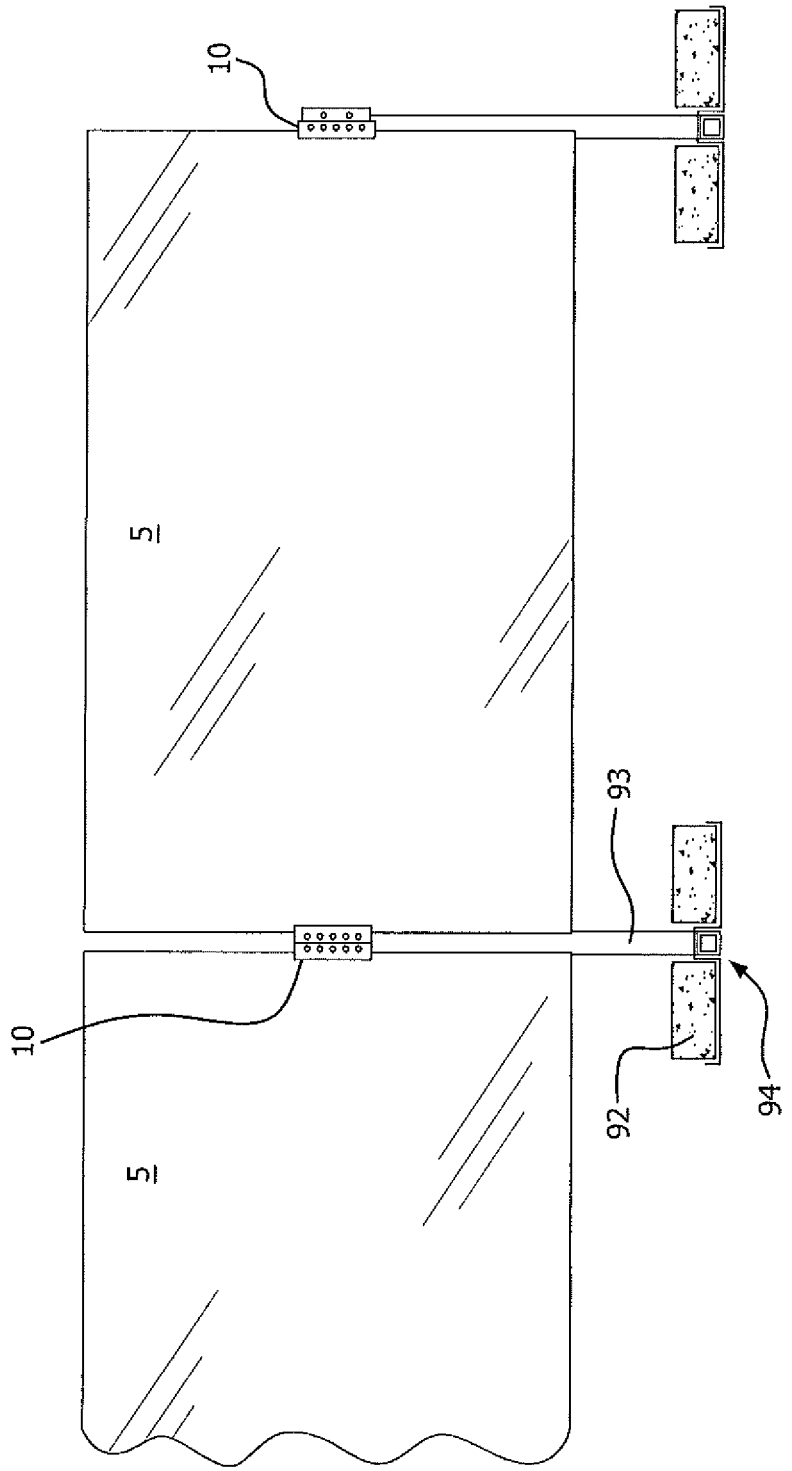


FIG. 10

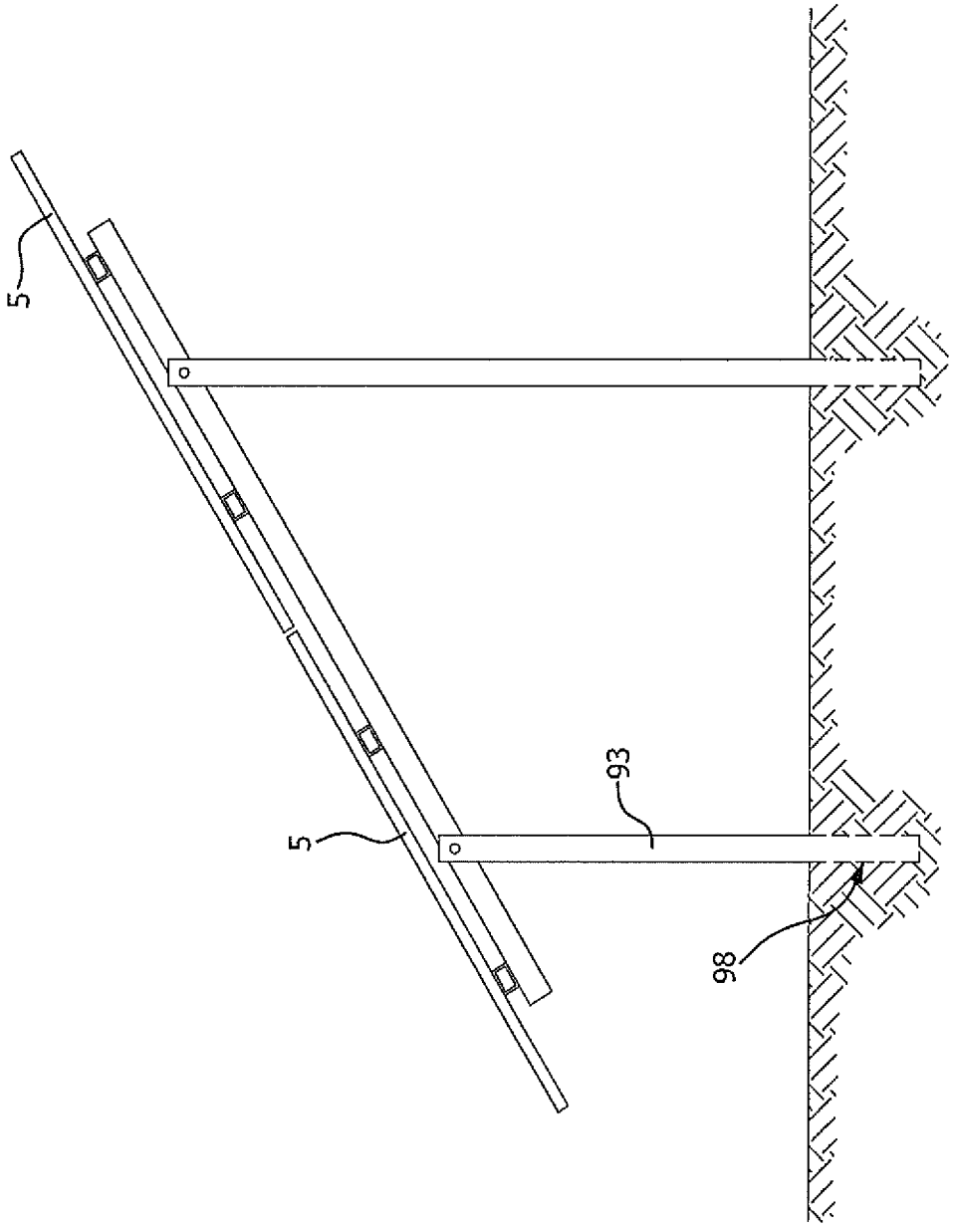


FIG. 11

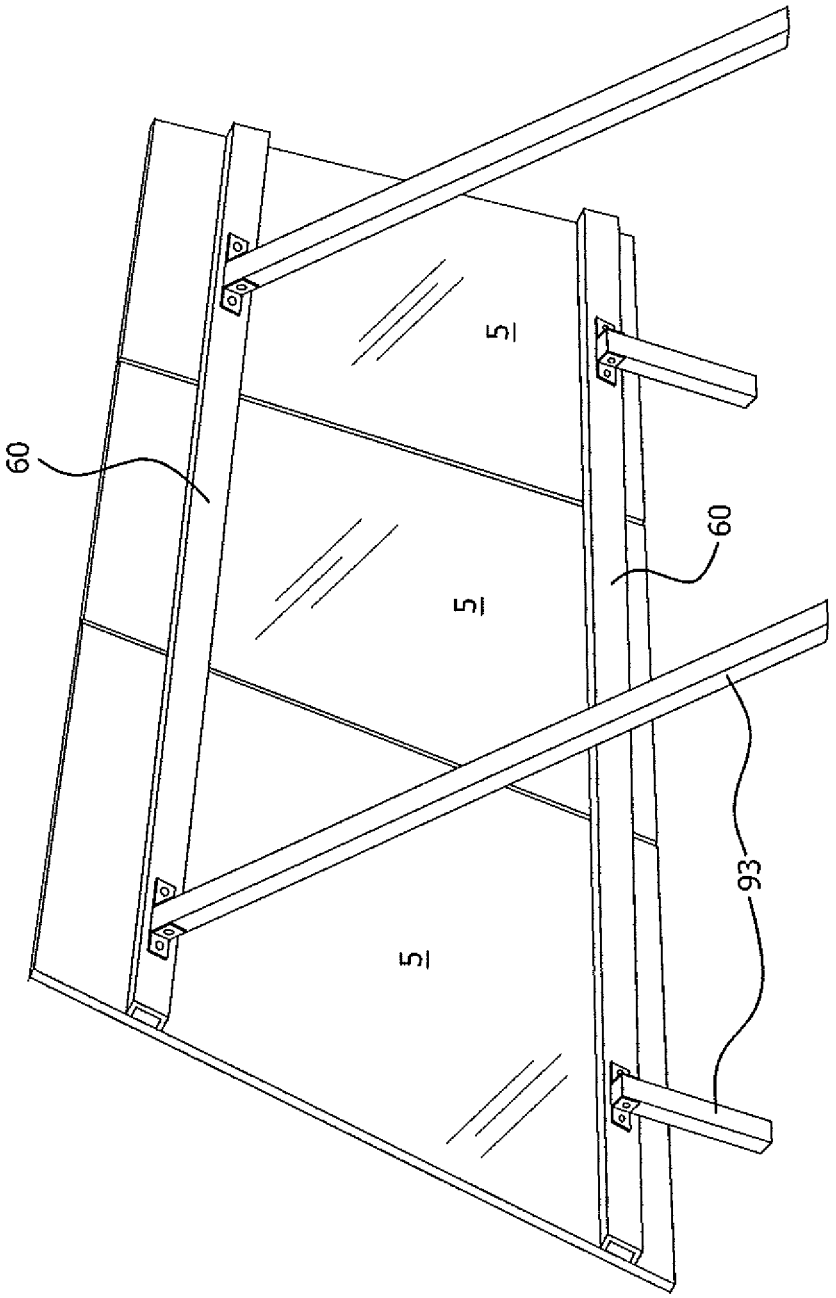


FIG. 12

PANEL CLAMPING AND MOUNTING MECHANISM

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application claims priority under 35 U.S.C. §119(e) to U.S. Provisional Application Nos. 61/459,267, filed Dec. 10, 2010, 61/464,911, filed Mar. 11, 2011 and 61/571,210, filed Jun. 23, 2011, the entire disclosures of which are incorporated by reference herein as if each being set forth herein in its entirety.

BACKGROUND OF THE INVENTION

Due to the continued increase in cost and environmental impact of fossil fuels, solar panels have always been recognized in the alternative energy market as a commercially viable mechanism for capturing renewable energy. However, one drawback to the use of solar panels is that solar panels generally occupy a significant amount of space. So as not to use up desirable space, solar panels are often mounted on rooftops or exterior walls of existing buildings. In areas where ground space is plentiful, ground-mounted solar panel systems or arrays also have been constructed by mounting solar panels on supports.

Unfortunately, existing mounting systems are generally difficult to assemble and disassemble. In many cases, whole rows of solar panels must be removed simply to access the one panel in need of repair. Therefore, there is a need in the art for a system and method for mounting panels that allows for a cost-effective and improved speed of assembly and disassembly, as well as for improved accessibility of individual panels within a solar panel array. The present invention satisfies this need.

SUMMARY OF THE INVENTION

The present invention relates to a panel clamp. The panel clamp includes first and second members, each having a top surface, a bottom surface and a side surface, wherein the top surface of each member includes an edge extending beyond at least a portion of its side surface to form an overhang, and wherein a plurality of holes pass through the top and bottom surfaces of each member, and a plurality of mechanical fasteners, wherein, when the overhang of the first member is fitted over a top surface of a panel and the overhang of the second member is fitted over a bottom surface of the panel, such that the plurality of holes in the first member is substantially aligned with the plurality of holes in the second member, the plurality of mechanical fasteners can be inserted through the plurality of holes to secure the first and second members to the panel. In one embodiment, at least two of the aligned holes receive a mechanical fastener to secure the first and second members to the panel. In another embodiment, at least one of the aligned holes receives a mechanical fastener to secure the panel clamp to a surface mount. In another embodiment, the surface mount comprises a bracket. In another embodiment, the surface mount comprises a rail. In another embodiment, the panel is a photovoltaic (PV) module. In another embodiment, the panel is a liquid crystal display (LCD).

The present invention also relates to a system for securing a panel to a surface. The system includes a panel clamp comprising first and second members, each having a top surface, a bottom surface and a side surface, wherein the top surface of each member includes an edge extending beyond at least a portion of its side surface to form an overhang, and wherein a plurality of holes pass through the top and bottom surfaces of each member, a plurality of mechanical fasteners, and a mount comprising a surface anchoring plate, a panel clamp anchoring plate and a support element connecting the surface anchoring plate to the clamp anchoring plate, wherein the surface anchoring plate and the clamp anchoring plate each have a plurality of holes therethrough, wherein, when the overhang of the first member is fitted over a top surface of a panel and the overhang of the second member is fitted over a bottom surface of the panel, such that the plurality of holes in the first member is substantially aligned with the plurality of holes in the second member, at least one of the mechanical fasteners can be inserted through the plurality of holes to secure the first and second members to the panel to form a panel clamp, and wherein the mount is secured to a surface by inserting at least one of the mechanical fasteners through the holes of the surface anchoring plate and into the surface, and the panel clamp is secured to the mount by inserting at least one of the mechanical fasteners through at least one of the aligned holes of the panel clamp into at least one of the holes in the clamp anchoring plate. In one embodiment, at least two of the mechanical fasteners are inserted to secure the first and second members to the panel. In another embodiment, the panel is a photovoltaic (PV) module. In another embodiment, the panel is a liquid crystal display (LCD). In another embodiment, the distance between the surface anchoring plate and the clamp anchoring plate is adjustable. In another embodiment, the support element is a bolt that engages a threaded hole in either or both of the surface anchoring plate and the clamp anchoring plate, and adjustment is made by either rotation of the bolt in one or both of the holes in the surface anchoring plate and the clamp anchoring plate, or by rotation of either the surface anchoring plate or the clamp anchoring plate about the bolt.

The present invention also relates to an adjustable panel mount. The mount includes a mounting arm having a front surface and a back surface, and a distal end that includes first and second holes passing through the front and back surfaces thereof, a mounting head having a front plate, a back plate and a top plate connecting the front and back plates, such that a space between the front and back plates is formed underneath the top plate, wherein the top plate has a plurality of holes passing therethrough, and the front and back plates have a plurality of aligned holes passing therethrough, and a plurality of mechanical fasteners, wherein, when the front and back plates of the mounting head are fitted overtop or within the distal end of the mounting arm and at least two of the aligned holes of the front and back plates of the mounting head are also aligned with the first and second holes of the mounting arm, a first mechanical fastener can be inserted through the aligned holes incorporating the first hole of the mounting arm to secure the mounting head to the mounting arm, and a second mechanical fastener can be inserted through the aligned holes incorporating the second hole of the mounting arm to position the top plate of the mounting head at a desired angle. In one embodiment, at least one of the aligned holes in the front and back plates of the mounting head provide different angles of the top plate of the mounting head. In another embodiment, the mount includes a panel clamp, the panel clamp comprising first and second members, each having a top surface, a bottom surface and a side surface, wherein the top surface of each member includes an edge extending beyond at least a portion of its side surface to form an overhang, and wherein a plurality of holes pass through the top and bottom surfaces of each member, a plurality of mechanical fasteners, wherein, when the overhang of the first member

is fitted over a top surface of a panel and the overhang of the second member is fitted over a bottom surface of the panel, such that the plurality of holes in the first member is substantially aligned with the plurality of holes in the second member, at least one of the mechanical fasteners can be inserted through the plurality of holes of the first and second members to secure the first and second members to the panel to form a panel clamp, and wherein the panel clamp is secured to the top plate of the mounting head by inserting at least one of the mechanical fasteners through at least one of the aligned holes of the panel clamp into at least one of the holes in the top plate of the mounting head.

The present invention also relates to a system for securing a panel to a mount. The system includes a panel clamp comprising first and second members, each having a top surface, a bottom surface and a side surface, wherein the top surface of each member includes an edge extending beyond at least a portion of its side surface to form an overhang, and wherein a plurality of holes pass through the top and bottom surfaces of each member, a plurality of mechanical fasteners, and a mount that includes a frame having a base, side walls and opposing grooves extending inwardly toward each other, and a rail plate having flange portions on opposing sides of the rail plate, such that the flange portion on each side of the rail plate fits slidably within the opposing grooves of the frame, and wherein the rail plate includes a plurality of holes passing therethrough, wherein, when the overhang of the first member is fitted over a top surface of a panel and the overhang of the second member is fitted over a bottom surface of the panel, such that the plurality of holes in the first member is substantially aligned with the plurality of holes in the second member, at least one of the mechanical fasteners can be inserted through the plurality of holes to secure the first and second members to the panel to form a panel clamp, and wherein the panel clamp is secured to the mount by inserting at least one of the mechanical fasteners through at least one of the aligned holes of the panel clamp into at least one of the holes in the rail plate. In another embodiment, the base of the frame further includes at least one hole passing therethrough, such that a mechanical fastener may be inserted through the at least one hole of the frame base to secure the mount to a rail of a second mount.

BRIEF DESCRIPTION OF THE DRAWINGS

For the purpose of illustrating the invention, there are depicted in the drawings certain embodiments of the invention. However, the invention is not limited to the precise arrangements and instrumentalities of the embodiments depicted in the drawings.

FIG. **1** is a schematic perspective view of an exemplary panel clamping and mounting mechanism, according to an aspect of the present invention.

FIG. **2**, comprising FIGS. **2**A-**2**C, is an exemplary clamping mechanism, according to an aspect of the present invention. FIG. **2**A is a perspective view of the top and bottom plates of the clamping mechanism, FIG. **2**B is a side view of a clamp plate, and FIG. **2**C is a front view of a clamp plate.

FIG. **3**, comprising FIGS. **3**A-**3**B, is an exemplary adjustable mounting mechanism, according to an aspect of the present invention. FIG. **3**A is a perspective view of an adjustable mount. FIG. **3**B is a side view of the adjustable mount of FIG. **3**A.

FIG. **4** is a side view of an exemplary panel clamping and mounting mechanism, according to an aspect of the present invention, where the mounting head is adjustable.

FIG. **5**, comprising FIGS. **5**A-**5**B, is an exemplary adjustable mounting head, according to an aspect of the present invention. FIG. **5**A is a front view of the adjustable mounting head, and FIG. **5**B is a perspective view of the adjustable mounting head.

FIG. **6**, comprising FIGS. **6**A-**6**B, is an exemplary mounting arm for the adjustable mounting head of FIG. **5**, FIG. **6**A is a front view of the mounting arm, and FIG. **6**B is a side view of the mounting arm.

FIG. **7** is a side view of an exemplary panel clamping and rail mounting mechanism, according to an aspect of the present invention.

FIG. **8** is a perspective view of an exemplary rail mounting mechanism for a large scale utility frame, according to an aspect of the present invention.

FIG. **9** is a perspective view of an exemplary panel array on the rail mounting mechanism of FIG. **8**, according to an aspect of the present invention.

FIG. **10** is a front view of an exemplary panel array attached to supportive legs held down with a ballast pan and weight, according to an aspect of the present invention.

FIG. **11** is a side view of an exemplary panel array attached to supportive legs that are buried into the mounting surface, according to an aspect of the present invention.

FIG. **12** is a perspective view of an exemplary panel array on a rail mounting mechanism attached to support legs, according to an aspect of the present invention.

DETAILED DESCRIPTION

It is to be understood that the figures and descriptions of the present invention have been simplified to illustrate elements that are relevant for a clear understanding of the present invention, while eliminating, for the purpose of clarity, many other elements found in panel mounting systems and methods. Those of ordinary skill in the art may recognize that other elements and/or steps are desirable and/or required in implementing the present invention. However, because such elements and steps are well known in the art, and because they do not facilitate a better understanding of the present invention, a discussion of such elements and steps is not provided herein. The disclosure herein is directed to all such variations and modifications to such elements and methods known to those skilled in the art.

Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. Although any methods and materials similar or equivalent to those described herein can be used in the practice or testing of the present invention, the preferred methods and materials are described.

As used herein, each of the following terms has the meaning associated with it in this section.

The articles "a" and "an" are used herein to refer to one or to more than one (i.e., to at least one) of the grammatical object of the article. By way of example, "an element" means one element or more than one element.

"About" as used herein when referring to a measurable value such as an amount, a temporal duration, and the like, is meant to encompass variations of ±20% or ±10%, more preferably ±5%, even more preferably ±1%, and still more preferably ±0.1% from the specified value, as such variations are appropriate to perform the disclosed methods.

"Holes" as used herein may include any opening suitable for receiving a bolt, pin or other mechanical fastener for securing two components together. Such holes may be smooth, so as to receive a pin, or they may be threaded, so as

to receive a screw or bolt. Holes should not be construed as being limited to any particular type of hole designed for receiving a particular mechanical component.

"Mechanical fastener" as used herein may include any device that holds two or more objects together. Exemplary mechanical fasteners are, without limitation, a bolt, screw, rivet or pin.

"Panel" as used herein may include any structure having a perimeter with at least one edge having a portion that is substantially linear. Generally, a panel is rectangular in shape. Exemplary panels are photovoltaic (PV) modules, liquid-crystal displays (LCDs), and other generally rectangular objects.

"Surface" as used herein refers to the outermost or topmost boundary of an object. A surface may be a final surface to which a panel or panels is to be mounted to, such as a roof, wall or the ground, or it may be a portion of a component of the present invention, such as a top or bottom surface of a clamp plate or member.

Throughout this disclosure, various aspects of the invention can be presented in a range format. It should be understood that the description in range format is merely for convenience and brevity and should not be construed as an inflexible limitation on the scope of the invention. Accordingly, the description of a range should be considered to have specifically disclosed all the possible subranges as well as individual numerical values within that range. For example, description of a range such as from 1 to 6 should be considered to have specifically disclosed subranges such as from 1 to 3, from 1 to 4, from 1 to 5, from 2 to 4, from 2 to 6, from 3 to 6 etc., as well as individual numbers within that range, for example, 1, 2, 2.7, 3, 4, 5, 5.3, 6 and any whole and partial increments therebetween. This applies regardless of the breadth of the range.

The present invention includes a system that is designed for mounting virtually any size panel, such as a PV module or LCD, onto a surface, such as on the ground, on the roof or on an interior or exterior wall of a commercial or residential building. The surface may be flat, graded or multi-tiered, and may be horizontal, vertical, or at any angle therebetween. Further, the surface may form part of a mobile object, such as a truck, recreational vehicle (RV), bus, car, boat, train, plane, or any object attached thereto. As contemplated herein, the present invention is not limited to the mounting of PV modules, but rather is suitable for mounting any sort of panel or structure having at least one substantially linear edge. Thus, while the exemplary embodiments relate particularly to the mounting of PV modules, it should be appreciated that any sort of panel may be mounted as described and illustrated herein.

Generally, the system of the present invention includes two primary components. The first component includes a clamping mechanism that fastens onto the PV module, while the second component includes a mounting mechanism that fastens both to the clamping mechanism and to the desired roof or wall surface.

In an exemplary embodiment, the clamping mechanism may include two plates and two bolts. In this example, one plate rests on top and along an edge of the outer frame of the PV module, while the second plate rests on the corresponding bottom portion of the outer frame of the PV module, such that, when fastened together by the two screws, the two plates form a clamp onto the outer frame of the PV module. Further, the clamp can be adjusted according to both the thickness of the panel frame, as well as its position anywhere along the perimeter of the frame of the PV module. The clamping mechanism generally includes three holes for tightening the clamp as well as for attaching the clamp to the mounting mechanism as described herein. In other embodiments, the clamping mechanism may include additional holes in the plates, such as 4, 5, 6, 7, 8, 9, 10 or any desired number. In an embodiment including three holes, two of the holes are used for the screws to fasten the two plates together on the PV module frame, while the third hole is used for a third bolt to go through and fasten the clamping mechanism to the mounting mechanism, which may be, for example, a mounting bracket or mounting rail, as described in further detail herein. There is no limitation to the positioning of the holes, either for tightening of the clamping mechanism or for attaching the clamping mechanism to the desired mounting mechanism.

As illustrated in FIGS. **1** and **2**, the present invention includes a clamping mechanism **10** suitable for attachment to a panel **5**, such as a solar panel, and is separately attachable to a mount **30**, for mounting panel **5** to a surface, such as the roof or wall of a building. As contemplated herein, the present invention is suitable for mounting on a surface having any angle, such as a substantially horizontal or 0° surface, a substantially vertical or 90° surface, or any angle or pitch between 0-90°.

As shown in FIGS. **1** and **2**A, clamping mechanism **10** includes a first or top plate or member **12** and a second or bottom plate or member **14**. Both top and bottom plates **12** and **14** have matching holes **15**, **17** and **19** passing through plates **12** and **14**, such that holes **15**, **17** and **19** of each plate are aligned when clamping panel **5**. In the embodiment of FIGS. **1** and **2**, holes **15** and **17** are suitable for securing top and bottom clamping plates **12** and **14** together with bolts, while hole **19** is suitable for securing the assembled clamp to a mounting mechanism that is securable to the desired surface. Plates **12** and **14** also include an extended lip or edge **13**, which serves to extend slightly over the top and bottom surfaces of panel **5** to create an enhanced grasping area for engaging or fitting onto panel **5**.

Clamping mechanism **10** engages and clamps panel **5** as follows. Top plate **12** is positioned such that its extended edge **13** rests on the front face of panel **5**, with the remainder of top plate **12** aligned along the side of panel **5**, with holes **15**, **17** and **19** running substantially vertical or otherwise substantially perpendicular to the plane of the front face of panel **5**. Bottom plate **14** is then positioned such that its extended edge **13** rests on the bottom face of panel **5** and the remainder of bottom plate **14** is substantially underneath top plate **12**, such that corresponding holes **15**, **17** and **19** are aligned. Bolts are inserted through holes **15** and **17** of both top and bottom plates **12** and **14** to securely attach the clamp to panel **5**. Alternatively, plates **12** and **14** may be positioned such that they bridge a gap between two adjacent panels, to secure the two panels together directly at their adjacent edges when positioned in a panel array. Depending on the type of panel and use of clamping mechanism **10**, the clamp can be secured tightly to panel **5**, such that the clamp cannot move along the side of panel **5**, or it can be secured in such a way that it can slide along the length of panel **5** without falling off. It should be appreciated that clamping mechanism **10** may further include any sort of textured surface on the portions of top and bottom plates **12** and **14** that contact panel **5**, such as extended edges **13** forming an overhang, to improve any of a friction grip, or the ability to slide along the side of panel **5**, as would be understood by those skilled in the art. For example, such textured surface may include small ridges, "teeth" or other contoured surface to improve grasping of the panel. Such regions may further include secondary materials to provide enhanced grasping, such as an adhesive or other chemical coating, or a rubber layer.

As contemplated herein, clamping mechanism **10** may come in virtually any length, such as any length from 1 in. to 10 ft., more preferably any length from 4 in. to 12 in., for example, where the desired length will depend on the size and/or type of panel being mounted. Top and bottom plates **12** and **14** may be constructed from any suitable building material that provides sufficient strength, rigidity and durability, such as aluminum and other metals and metal alloys, galvanized metals/alloys, moldable polymers and polymer blends, rubber and the like. All bolts, pins or other mechanical fasteners may be of a standard size and commercially available, such as bolts ranging from ¼ to ½ in. Consequently, the diameter of any particular hole will be based on the desired mechanical fastener to be received therein.

Clamping mechanism **10** is designed to engage and/or be secured to a variety of mounting mechanisms. By having clamping mechanism **10** separate from the mounting mechanism, an installer has the ability to remove a particular clamped panel at any time by removing a single bolt, without other panels being affected and without disrupting the mount as secured to the desired surface.

For example, referring again to FIG. **1**, mount **30** may generally include a surface anchoring plate **34** for anchoring the mount to a roof, wall or other surface, a clamp anchoring plate **32** for securing clamping mechanism **10**, and a support element **33** (also referred to herein as a web, crossbeam, beam, etc.), transversing plates **32** and **34** for providing separation and supportive strength between surface anchoring plate **34** and clamp anchoring plate **32**. While plates **32** and **34** are illustrated as being substantially parallel with support element **33** running substantially perpendicular thereto, it should be appreciated that clamp anchoring plate **32** may be positioned at any desired angle compared to surface anchoring plate **34** or to support element **33**. For example, clamp anchoring plate **32** may be approximately 15°, 30°, 45°, 60°, 75°, 90°, 105°, 120°, 135°, 150° or 165° with respect to surface anchoring plate **34**. The length of the surface anchoring plate may be of any desirable size, such as ranging from 2 ft to 4 ft, depending on the size of the PV module and the number of such modules to be mounted. Surface anchoring plate **34** may be wide enough for a standard or custom ballast pan to sit on top of and to hold additional weight, as would be understood by those skilled in the art.

As illustrated in FIG. **1**, surface anchoring plate **34** includes two holes (not shown) through which lag bolts **36** and **38** may be inserted to securely anchor or otherwise fasten mount **30** to the roof or wall surface. The number and/or size of the holes in surface anchoring plate **34** is not limited to any particular number or size, and thus may alternatively include 1, 3, 4, 5, 6, 8, or any number of holes through which one or more bolts may be inserted to anchor mount **30** to the desired surface. The size of the holes should be commensurate with the type of bolt being inserted therethrough. Furthermore, the holes may be positioned anywhere in surface anchoring plate **34**.

Clamp anchoring plate **32** also includes a series of holes **31** for receiving bolt(s) **20** for securing clamping mechanism **10** to mount **30**. In one example, clamp anchoring plate **32** includes two rows of 5 holes running along the length of clamp anchoring plate **32** in parallel. In this example, each row of 5 holes may is suitable for securing a clamping mechanism **10**, such that two clamping mechanisms **10** may be secured, back-to-back, to clamp anchoring plate **32** at the same time. By having a series of holes in a row, a panel installer can elect which hole in the row is most suitable for attaching clamping mechanism **10** to mount **30**, thereby providing the installer the ability to adjust the positioning of clamping mechanism **10** not only on the panel itself, but also with respect to where it is fastened to mount **30**.

In another embodiment, mount **30** may be adjustable, such that an installer has the option to adjust the height of the panel from the surface, for example, to compensate for the warping of wood roofs, or to allow more heat to pass through the solar panels for more efficiency. For example, as shown in FIGS. **3**A and **3**B, clamp anchoring plate **32** and surface anchoring plate **34** are separate components held together by one or more bolts **39**, which may be a ½ inch thread bolt, for example. The distance between plates **32** and **34** can be adjusted via advancing or retracting bolt **39** through the threaded holes of either or both plates **32** and **34**, as would be understood by those skilled in the art. In other embodiments, such adjustment can be accomplished by other mechanical means as would be understood by those skilled in the art. For example, the support element between plates **32** and **34** may alternatively be a telescoping arm or beam, such that the distance between plates **32** and **34** may likewise be adjustable.

In another exemplary embodiment, the mounting mechanism can include means for "tilting" the attached panel, or otherwise adjusting the angle at which the panel is positioned relative to the surface mounted thereto. For example, as seen in FIG. **4**, clamping mechanism **10**, being secured to panel **5**, is fastened to adjustable mounting head **45**, which is also attached to mounting arm **42**. Mounting arm **42** is likewise secured to the desired surface **41** via any standard means as would be understood by those skilled in the art, including a standard bracket **40** bolted to surface **41**, by welding or any other attachment mechanism. In still other embodiments, mounting arm **42** and surface **41** may be integrated into a single "T" bar construct, which is itself secured to a desired surface. By adjusting the position of mounting head **45**, the angle of panel **5** can be altered relative to the desired surface.

As shown in FIGS. **5**A and **5**B, adjustable mounting head **45** may include front and back plates **43** attached together via top plate **44** to which clamping mechanism **10** is attached via holes **48**. While plates **43** are illustrated as being rounded, plates **43** may be any shape, including oval, square, rectangular, triangular or any other shape desired. Front and back plates **43** have corresponding or matching holes **47** and **49** for engaging and attaching to mounting arm **42**. Similarly, mounting arm **42** has corresponding holes **50** and **51** for attachment to adjustable mounting head **45**, has shown in FIGS. **6**A and **6**B. To attach mounting head **45** to mounting arm **42**, the attachment end **52** of mounting arm **42** containing holes **50** and **51** is fitted within (or outside of) front and back plates **43** of mounting head **45**, such that hole **49** of mounting head **45** is aligned with hole **50** of mounting arm **42**, and at least one of holes **47** of mounting head **45** is aligned with hole **51** of mounting arm **42**. Mounting arm **42** may include extended edges or plates, as illustrated in FIG. **6**B, which may or may not include holes **50** or **51**, or mounting arm **42** may not include any extended edges or plates. A bolt or pin may be inserted through holes **49** and **50** to secure mounting head **45** to mounting arm **42**, such that mounting head **42** can rotate or pivot freely around the bolt or pin. A second bolt or pin may be inserted through one of holes **47** and through hole **51** to lock the mounting head into place. By selecting a particular hole **47** to insert the bolt or pin through, the installer can thereby select the angle at which the panel is positioned relative to the surface. Mounting head **45** can include markings identifying what angles are achieved by selecting any particular hole **47**. For example, each hole **47** can represent a particular preset angle between and including 0° and 180°, such as 0°, 15°, 30°, 45°, 60°, 75°, 90°, 105°, 120°, 135°, 150°, 165° and 180°, by non-limiting example. It should be

appreciated that any number of holes **47** may be used, each representing any panel angle desired. In an alternative embodiment, the adjusting means may include or be replaced by other mechanical features for accomplishing the same goal, such mechanisms including spring loaded pins or spring actuated levers, detents and the like to divide the rotation of mounting head **45** into discrete increments, or otherwise resist or arrest such rotation at desired angles.

Holes **48** on top plate **44** of mounting head **45** are positioned to receive clamping mechanism **10** in a similar manner as described for attachment to clamp anchoring plate **32** of mount **30**. Top plate **44** also includes a series of holes **48** for receiving a bolt for securing clamping mechanism **10** to top plate **44** of mounting head **45**. Like the clamp anchoring plate of mount **30**, top plate **44** may include two rows of 2, 3, 4, 5, 6, 7, 8, 9, 10 or any other number of holes running along the length of top plate **44** in parallel. Each row of holes is suitable for securing a clamping mechanism **10**, such that two clamping mechanisms **10** may be secured, back-to-back, to top plate **44** of mounting head **45** at the same time. By having a series of holes in a row, a panel installer can elect which hole in the row is most suitable for attaching clamping mechanism **10** to mounting head **45**, thereby providing the installer the ability to adjust the positioning of clamping mechanism **10** not only on the panel itself, but also with respect to where it is fastened to the mount.

In another embodiment, clamping mechanism **10** may be attached to a rail mount. The mounting rail allows clamping mechanism **10** and attached panel **5** to slide within the rail system. As shown in FIG. **7**, the rail mount **60** includes a base frame **62** having two grooves **64**, in which a flange **68** on either side of sliding rail **66** fits, such that when flange **68** of rail **66** is positioned within grooves **64**, rail **66** may slide along the length of frame **62**. Rail **66** further includes an attachment point **67** which may include a series of holes (not shown) through which one or more bolts **20** of clamping mechanism **10** may engage rail **66**. Similar to the previously described mounts, the number and position of holes for receiving bolt **20** of clamping mechanism **10** can be any number and located in any position.

In an alternative embodiment, frame **62** may have multiple rails **66** positioned along its length, such that each rail **66** within frame **62** may have one or more panels attached to them. As contemplated herein, there is no limitation to the number of rails within rail mount **60**, and there is no limitation to the number of panels (attached by the clamping mechanisms) secured to each particular rail.

As shown in FIG. **7**, when bolt **20** is secured tightly to rail mount **60**, clamping mechanism **10** is forcibly held against frame **62**, thereby holding clamping mechanism **10** and rail **66** in place. If bolt **20** is loosened, clamping mechanism **10** and rail **66** may freely slide along the length of frame **62**. In alternative embodiments, the body of rail **66** (not including flange **68**) may be thicker and extend outward from the outer face of frame **62**, such that when clamping mechanism **10** is secured tightly to rail **66** via bolt **20**, rail **66** may still slide freely along the length of frame **62**.

The rail mount is particularly useful when assembling the base for a large scale utility frame, because there is no need to manufacture additional parts. For example, as shown in FIGS. **8** and **9**, an installer can secure one rail mount **70** into another rail mount **60**. Rail mount **60**, being similar to and having like parts as described in FIG. **7**, may include two holes (not shown) for receiving bolts **76**, instead of bolt **20** from a clamping mechanism. In this example, bolts **76** are used to secure the base of frame **72** onto rail **66** of rail mount **60** at any angle desired, such that rail mount **70** runs substantially perpendicular to rail mount **60**, or at any angle between and including 0° and 180°, as desired. As shown in FIG. **9**, a panel array **80** can be assembled, where each panel **5** has at least one clamping mechanism **10** attached thereto, which is in turn attached to rail mounts **70** in the same manner as previously described. Panel array **80** may be either attached to a plurality of mounting arms **82** and secured to the desired surface, or alternatively, panel array **80** can be directly secured to the desired surface via rail mounts **60**. In a further embodiment, rail mounts can be attached to other mounting mechanisms described herein, such as to mount **30** of FIG. **1**. In the event mounting arms **82** are used, such arms may be anchored to the rail mount and/or to the surface by standard attachment mechanisms as would be understood by those skilled in the art. Mounting arms **82** may further be adjustable in height, such as by telescoping means, for example, as would also be understood by those skilled in the art.

In another embodiment, clamping mechanism **10** can be fastened to a standard joint or bracket that is further attached to a plurality of supportive legs. As shown in FIG. **10**, clamping mechanism **10** may be secured to panels **5**, and further attached to support legs **93** by a joint, bracket, or other attachment mechanism (not shown). The size of the leg joint can range from 1 inch to 10 feet in length. The joint may also be used for single or double leg **93** mounting. Support legs **93** may range from 1 to 20 feet in length, and may be fastened to the surface by bolts, or alternatively to a ballast pan **94** for holding weights **92**, such as concrete blocks. Support legs **93** may further be a "T" bar support, such that the crossbeam of the "T" bar is positioned on the desired mounting surface, and ballast pan **94** rests overtop the crossbeam component of support leg **93**, as shown in FIG. **10**. Alternatively, ballast pan **94** may include grooves where metal plates can slide through for weights **92** to hold down supportive legs **93**. In other embodiments, the ballast pan can be replaced by a series of one or more rods, wherein the rods can pass through the support legs or overtop the support legs, such that weights **92** can be positioned overtop the rods to hold down and support the structure. If an array of panels is desired and multiple mounts/support legs are used, the rods could pass through the legs of each mounting mechanism, with the rods only being secured directly to the desired surface at either end of the array. This would reduce the number of times an installer would need to puncture a roof to support the panel array, for example. In still other embodiments, such as that shown in FIG. **11**, supportive legs **93** may be buried into the desired surface (**98**). In the embodiments of FIGS. **11** and **12**, supportive legs **93** may be attached to a rail mount system, as previously described.

Any of the mounting mechanisms described herein may be constructed from any suitable building material that provides sufficient strength, rigidity and durability, such as metals, galvanized metals, moldable polymers and polymer blends, rubber and the like. All bolts, pins or other mechanical fastening components may be customized or of a standard size and commercially available. Consequently, the diameter of any particular hole will be based on the desired bolt or pin to be received therein.

In other embodiments, the clamping mechanism and/or mounting mechanism may include a grounding lug. In other embodiments, the clamping and/or mounting mechanism may include a microinverter in communication therewith. In further alternative embodiments, the clamping mechanism can be integrated into any of the mounting mechanisms as described hereinthroughout, such that the clamp and mount form a single piece or unit. In still other embodiments, the clamping mechanism may be slidably attached to a mount,

such as by a fitted flange and groove sliding system. It should be appreciated that the clamping mechanism may alternatively be attached or integrated with mount by any means understood by those skilled in the art. In this way, the single unit clamp-mount can be securely fastened to the desired surface, and the panel can be placed within the loose clamp portion by the installer. Once the panel is positioned in the desired spot, the installer can tighten the clamp to secure the panel to the mount.

The disclosures of each and every patent, patent application, and publication cited herein are hereby incorporated herein by reference in their entirety.

While this invention has been disclosed with reference to specific embodiments, it is apparent that other embodiments and variations of this invention may be devised by others skilled in the art without departing from the true spirit and scope of the invention. The appended claims are intended to be construed to include all such embodiments and equivalent variations.

What is claimed:

1. A system for securing a panel to a surface, comprising:

a panel clamp comprising first and second members, each having a top surface, a bottom surface and a side surface, wherein the top surface of each member includes an edge extending beyond at least a portion of its side surface to form an overhang, and wherein at least one hole passes through the top and bottom surfaces of each member;

a plurality of mechanical fasteners; and

a mount comprising a surface anchoring plate, a panel clamp anchoring plate and a support element connecting the surface anchoring plate to the clamp anchoring plate, wherein the surface anchoring plate and the clamp anchoring plate each have at least one hole therethrough;

wherein, when the overhang of the first member is fitted over a top surface of a panel and the overhang of the second member is fitted over a bottom surface of the panel, such that the at least one hole in the first member is substantially aligned with the at least one hole in the second member, at least one of the mechanical fasteners can be inserted through the at least one hole to secure the first and second members to the panel to form a panel clamp; and

wherein the mount is secured to a surface by inserting at least one of the mechanical fasteners through the at least one hole of the surface anchoring plate and into the surface, and the panel clamp is secured to the mount by inserting at least one of the mechanical fasteners through the at least one aligned hole of the panel clamp into the at least one hole in the clamp anchoring plate.

2. The system of claim **1**, wherein at least one of the mechanical fasteners is inserted to secure the first and second members to the panel.

3. The system of claim **1**, wherein the panel is a photovoltaic (PV) module.

4. The system of claim **1**, wherein the panel is a liquid crystal display (LCD).

5. The system of claim **1**, wherein the distance between the surface anchoring plate and the clamp anchoring plate is adjustable.

6. The system of claim **5**, wherein the support element is a bolt that engages a threaded hole in either or both of the surface anchoring plate and the clamp anchoring plate, and adjustment is made by either rotation of the bolt in one or both of the holes in the surface anchoring plate and the clamp anchoring plate, or by rotation of either the surface anchoring plate or the clamp anchoring plate about the bolt.

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